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country, shown to be imminent, could not take place without the grant and transfer of land. It became indispensably necessary therefore to inquire with whom, if with any one but the Crown, a title to grant lay, and to what that title amounted and over what it extended. To effect a legal transfer there must be a legal title. That title, if legal, extended over Rupert Land. Hence the interest and importance of the question—What are its limits?

The PRESIDENT, in thanking Captain Synge for his communication, said the Geographical Society, happily, were not called upon to settle that question.

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2. *On the discharge of Water from the Interior of Greenland, through Springs underneath the Ice.* By DR. H. RINK, of Greenland.

DR. RINK calculates the yearly amount of precipitation on Greenland, in the form of snow and rain, at 12 inches, and that of the outpour of ice by its glaciers at 2 inches. He considers that only a small part of the remaining 10 inches is disposed of by evaporation, and argues that the remainder must be carried to the sea in the form of sub-glacial rivers. He shows that copious springs of fresh water boil up through the sea in front of the glaciers that advance into it, and states that their positions are conspicuously pointed out by flocks of sea-birds, which invariably hover over them in evident search of some food, whatever it may be, which they always find there. He also specifies a lake adjacent to the outfall of a glacier into the sea, which has an irregularly intermittent rise and fall. Whenever it rises the sea-springs disappear; when it sinks they burst out afresh, showing a direct connection between the springs and a sub-glacial river. Arguing from what has been observed in the Alps, he concludes that an amount of glacier-water equivalent to 10 inches of precipitation on the whole surface of Greenland, is no extravagant hypothesis, and he accounts for its presence partly by the transmission of terrestrial heat to the lowest layer of the ice, and partly from the fact that the summer heats are conveyed into the body of the glacier, while the winter cold never reaches it. The heat melts the surface-snow into water, which percolates the ice, while the cold penetrates a very inconsiderable portion of the glacier, whose thickness exceeds 2000 feet.

The PRESIDENT said this was a most important communication. Dr. Rink brought before them the most convincing proof of the truth of what had been long established by the labours of Agassiz, Forbes, and Charpentier, and other geologists, that glaciers were simply frozen rivers; and, in showing that these frozen masses move to the coast, he has calculated that about one-sixth of their whole volume really consists of water. The subject was of great interest, particularly to persons who, like himself, happened to have been born in the north of Scotland; because geologists had recently satisfied themselves that all the northern part of Scotland has been under pre-

cisely the same conditions as Greenland is now, covered in its centre by great snowy frozen masses, which advanced towards the coast, and emptied themselves by glaciers. They were fortunate in having valuable illustrations of Dr. Rink's Paper, furnished by Colonel Shaffner, who went out with the first expedition to determine the possibility of establishing telegraphic communication with these countries, and to ascertain the nature of the difficulties in approaching these great glaciers. It was the latter difficulty which had been particularly adverted to by the author of the Paper: and he described how in one of these great masses of ice they even found an interior lake. This was a point exceedingly interesting to geologists, for they had recently had under discussion the subject of the parallel roads of Glenroy, in the Highlands, where it seemed impossible to account for certain terraces of gravel at different altitudes, except upon the supposition that there was once an interior lake there, which was barred up by a glacier. This icy lake spoken of by Dr. Rink seemed to throw some light upon the subject. As his friend Professor Ramsay the President of the Geological Society, who had written most ably upon glacial action, both in our own country and in the Alps, was present, he should be happy to hear his observations on the subject.

Professor RAMSAY said the study of glacial phenomena had been for many years a subject of special interest to him, for, as geologists knew, much of the northern hemisphere had at one time been as deeply buried under ice as Greenland was now. He believed that all those appearances which thrust themselves on glacialists wherever they went in the north of Europe, would never be clearly understood until they had been studied in Greenland by a man who, besides being a mere student of ice, was thoroughly conversant with all the glacial phenomena of that period of time when the northern hemisphere was, to a great extent, covered by ice. This ancient ice-covering was positively true; for all the phenomena that glacialists are familiar with in Switzerland, from the days of De Saussure downwards, are as clearly written upon the rocks of our own island, of the Scandinavian peninsula, of the Black Forest, of the Vosges, of the highlands of Scotland and Wales, as they are upon the Alps in places which the ice only left, as it were, last year. Until people went and saw what was going on in Greenland, which was now undergoing the very same process that our own island underwent, there would inevitably be a great many phenomena which we could not clearly understand. The Paper was an exceedingly clear exposition of some part of these phenomena, but he was bound to say it was an exposition of what most men who had studied ice were familiar with. The author wished clearly to show that the country was drained by ice, but drained not by ice alone, but by water flowing under the ice. Everyone who had visited the glacier of the Rhone, or the glacier of the Aar, or the Glacier du Bois, must have seen a ready-made river from under the ice flowing out upon the land. Dr. Rink explained that the same ready-made rivers flowed from under the ice as it floated out to sea, and rose to the surface, as it were, in boiling springs. This rush of water was due, not to the circumstance merely of springs rising out of the rocks underneath the ice, but more to the circumstance that the ice a few feet below the surface, even in the extremest cold of the most Arctic winters, was always just about melting temperature. Dr. Sutherland, who went in one of the voyages in search of Sir John Franklin, observed that the surface of the ice in extreme Arctic regions, unlike the surface of the ice in the glaciers of the Alps, is much more rugged, because the extremest cold never penetrates down below a depth of 8 or 10 feet. To that depth all ice is frozen below the temperature of  $32^{\circ}$ ; but below that depth, even in winter, the temperature is always at  $32^{\circ}$ , a little more or less, and the lower strata of ice flowing faster than the upper, the upper strata are broken in this irregular manner. Some years ago Dr. Kane showed that all the winter through, from underneath a glacier which he estimated at 3000 feet in thick-

ness, a stream of fresh water was constantly flowing. Here, therefore, we had a confirmation of the observations made by Dr. Rink, which in this respect are not new, though he has brought it before us in a very prominent manner.

Dr. RÆ said one of the glaciers he visited had been evidently an ice-giving-off glacier at one time, but the quantity of mud formed from the trituration of the rocks by ice-action, and carried down by the rivers of which Dr. Rink had spoken, had probably filled up the head of the fiord, so that the ice had not had depth of water enough to float it off. With regard to the number of birds seen at the "springs" usually found near the edge of an ice-blink, the birds went there to feed on certain small marine insects resembling very minute shrimps, which on the Arctic coast are almost invariably found where fresh water flows into the salt. These insects being brought to the surface by the flowing upwards of the fresh water through the salt, in consequence of its less specific gravity, are easily caught by the gulls and other waterfowl.

Mr. ROBERT CHAMBERS said, in his opinion, this Paper and the former Paper of Dr. Rink only partially illustrated the great glacial subject. He thought this glacier spoken of resembled the sub-aërial glaciers which are found in Alpine regions, only that it was spread over a wider extent of country. They had only to imagine the sea about 3000 feet higher than it is round the Alps, and they would have the *Glacier du Bois* discharging itself into the sea in the same way that this Greenland glacier was now doing. What he wished more particularly to remark was, that the early general glaciation of the northern regions, by which the surface of those countries had been moulded, and which was chronicled in Scotland by the boulder clay, was, in his opinion, independent of such explanations as this.

COLONEL SHAFFNER explained the diagrams he had prepared, representing the various glaciers, fiords, and icebergs on the coast of Greenland.

The Meeting was then adjourned.

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## ADDITIONAL NOTICE.

(Printed by order of Council.)

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1. *Extracts from a Letter of SAMUEL W. BAKER, Esq., F.R.G.S., to Rear-Admiral the Hon. HENRY MURRAY. Dated Khartûm, 24th Nov., 1862.*

"THE steamer engaged by the adventurous Dutch ladies returned from Gondokoro on the 19th instant, bringing unsatisfactory news of Petherick. He left Abookooka (in the Kytch country) about the 15th July. The steamer left this spot about 31st last month (October), thus *three months and a half* had elapsed since Petherick's departure. From Abookooka he had been obliged to force porters for the land journey. He left the greater portion of his stores at Poncet's dépôt at that place, and returned to Khartûm three boats with an immense amount of effects damaged by the rains. Instead of proceeding direct to Gondokoro from Abookooka as I had supposed, by a route said to be firm ground, he went to his ivory establishment in the Jamberra, on the Djour, in a s.s.w. direction. This route is said to be almost impassable during the rains, as the tract of country is intersected by numerous large *hors* or rivers and deep morasses, which are at that season flooded. Since